

Running Head: MEETING NFPA 1710 RESPONSE TIMES

Executive Leadership

Exploring the Feasibility of Meeting
NFPA 1710 Response Time Standards
at Northwest Fire/Rescue District

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January 2008

CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

The problem investigated was why Northwest Fire/Rescue District (NWFD) was not meeting NFPA 1710 response standards. The research purpose was to identify reasons why NWFD was not meeting the response standards. Through the use of descriptive research that included review of existing published literature, in-house surveys, and personal communications with other fire departments/districts, reasons for the response time deficiencies were identified. The results showed that there were numerous factors that contributed to problem. The research also discovered many factors that NWFD could evaluate to improve response times. An unexpected result of the research was that while efforts need to be made to improve response times, time and effort may be better spent on prevention activities to prevent the emergencies from occurring.

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Introduction

Until 2005, the Northwest Fire/Rescue District (NWFD) had only informally tracked response times in the typical “average” response time method. Since NWFD’s inception in 1984, many other issues that typically confront a young organization overshadowed emphasis on response times. In 2004 a more concentrated effort was initiated for response times that came about as a result of a more focused use of the National Fire Protection Association (NFPA) Standard 1710 as a planning tool and the district’s initial efforts to become accredited by the Commission on Fire Accreditation International. Early in this process it was recognized that meeting the NFPA 1710 response time standards would be a challenge. This conclusion was primarily based on the broad spectrum of service areas within the District boundaries, from areas of frontier type/undeveloped land, to areas that meet most published criteria for urban density. The conclusion was verified by data analysis put into place as part of the accreditation process. The data showed that response times were exceeding five minutes in the highly developed areas of the district, and approximately eight minutes for less developed areas of the district.

The research problem was NWFD had never formally researched why the District was not meeting NFPA 1710 standards. The purpose of the research was to provide senior management of Northwest Fire/Rescue District definitive reasons why the response times were not meeting NFPA 1710 standards and to provide potential solutions for improving and maintaining response times.

Descriptive research was used to study the problem and formulate solutions. Research questions included the following:

1. What is the present response time performance for NWFD?
2. What are the NFPA response time standards based on?
3. Are there other professional fire/EMS organizations that are meeting NFPA 1710 response time standards and if so, how are they accomplishing them?
4. What are the major tangible factors at NWFD that are contributing to not meeting NFPA 1710 response times?

Background and Significance

Response times have long been a significant factor of service delivery for fire and rescue organizations. Coleman and Granito (1988) describe the need for determining an acceptable level of risk for a community, and in turn, determining appropriate response times as part of the overall risk management program. In a later edition of *Managing Fire and Rescue Services*, Compton and Granito reference the interim report of the Tricon Consortium regarding the importance of response times to the public. “Customers expect the department to come quick, solve my problem, be nice, stay safe and be well managed.” (2002, p.314). Vadnais (1990) states that response times are not only important to the public, but play a key role in firefighter safety. The earlier firefighters can intervene in a fire, keeping it at an incipient level, theoretically the safer they are.

The importance of adequate response times in the fire service seems obvious on the surface. Logic would seemingly indicate that the quicker help arrives, the quicker an emergency can be mitigated. This logic of course comes with an assumption that help arrives in the form of adequately equipped apparatus staffed with sufficient and adequately trained personnel. The perception is that time is the common adversary for all emergencies that a fire service organization responds to. Zikmund (2001) supports

this perception, “We think if we had only gotten there faster, we could have made a bigger difference (p.30). Castillo (2002) also alluded to the importance of response time referring to the faster crews can arrive at the scene of an emergency, the more likely there will be a positive outcome. The “time is of the essence” is not limited to the fire service. A Phoenix Police Department survey in the mid-90’s showed that the customer’s number one priority was emergency response times, and that the reasonable target time was five minutes (Brewster, 1994). In 2006, a survey conducted for NWFD by the Karl Eller School of Business at the University of Arizona reflected the results of the Phoenix PD study (2006). The survey clearly showed that response time was the number one expectation of those responding to the survey.

In 2005 a major metropolitan newspaper published a comprehensive report on fire department response times that received national attention. The *Boston Globe* published a two part series that focused on increased response times and decreased staffing (2005). The report received national attention when it was published by *USA Today*, and has been the subject of much discussion both within and outside the fire service. The report cited that nationwide only 35percent of the fire departments met NFPA 1710 response time standards for the first engine company. The report also linked property damage to response times, citing a 30 percent increase in damage when comparing response times of four minutes to eight minutes (Boston Globe, 2005). Following the publication of the Globe report, NWFD received several calls from residents as well as inquiries from local media regarding NWFD’s response times.

The International City/County Management Association has in recent years placed an emphasis on performance management of fire departments as well as other

city/county departments. It has created the Center for Performance Management which was established to create a comparable data base that centers on the quality and efficiency of various service delivery systems of cities and counties (2007). As a result of this program, it reports annually on a number of measureable factors including response times for both municipal and county fire departments/districts. Metcalf (2002) listed a number of “truths” that the ICMA has identified regarding performance management. These included “That without management performance isn’t being managed”, and “Without measurement there are no triggers for performance improvement” (p.6).

The issue of response times is addressed by the Commission of Fire Accreditation International (2006). This organization supports the development of a Standards of Response Coverage document that links risk assessment to the development of appropriate response times. This is addressed in further detail in the Literature Review section. As part of the CFAI accreditation process, NWFD governing fire board adopted a Standard of Response Coverage document based on CFAI guidelines in July 2006. This document is required to be updated and re-adopted yearly. As a result, response times are receiving much more attention than in the past by both senior staff and the fire board.

Northwest Fire/Rescue District was organized in 1984 by a group of concerned citizens in the unincorporated area of northwest Tucson who were dissatisfied with fire and rescue services that at the time were provided by a private entity, on a subscription basis. Staffing and response times were among the citizen’s top concerns regarding their current service provider. Beginning with three stations and approximately 30 full time employees, the District has grown rapidly since those modest beginnings. As of 2007

NWFD served its constituents from nine stations and with approximately 200 full time suppression personnel. Since the District's inception, the population of the District has nearly doubled, as has the geographic area the District serves. At the end of 2007, NWFD served approximately 115,000 people residing in approximately 140 square miles.

Like many other government entities, NWFD finds itself under increased scrutiny from the public that they serve. NWFD is primarily funded through property taxes. The District tax rate has risen from \$0.65 per hundred dollars of secondary assessed value in 1984, to \$2.45 for the fiscal year of 2007/2008. In recent years the increases in the tax rate (including a \$34M dollar bond issue) have primarily been to fund additional suppression and support staff, as well purchase additional apparatus and build new stations. This represents a tax increase of over three-fold, a homeowner that has a house with an assessed value of \$225,000 (approximate median value of a house in the NWFD service area) can expect to pay approximately \$600 in property taxes to NWFD. As a result, the district has seen in recent years an increase in taxpayer awareness and scrutiny regarding the performance of NWFD and how it is spending taxpayer dollars.

Further evidence of taxpayer dissatisfaction with government services can be seen with three ballot initiatives for property tax reform introduced in 2007 with the intent of being place on the November, 2008 ballot. These initiatives include the Arizona Tax Revolt Levy Limitation and Rollback Initiative, the Arizona Tax Revolt Assessed Valuation Initiative, and Proposition 13 Arizona (Arizona Federation of Taxpayers, 2007). All of these initiatives support in some form property tax rate rollbacks or caps on

tax rates. Passing of any of these initiatives would adversely affect future tax revenue for government entities such as NWFD that depend on property tax revenue for existence.

In 1999, NWFD began exploring the possibility of entering into the accreditation process, sponsored by the Commission of Fire Accreditation International. At the time, the governing Board at the urging of the fire chief, voted not to pursue accreditation as the District lacked much of the basic critical core criteria required by the process, and would not have these criteria in place for several years. However, the review of the accreditation process did set in motion several programs designed to eventually meet accreditation criteria. In 2004, the accreditation issue was again revisited and senior staff felt that the time had come to enter into the process. With Board approval in 2005, NWFD enrolled in the application process to become accredited. One of the basic requirements of accreditation is the development of a Standards of Response Coverage (SORC) documents.

Standards of Response Coverage is defined as those written policies and procedures that establish the distribution and concentration of fixed and mobile resources of a fire service organization (CFAI, 2006). One of the required sections of the SORC is Time and On-Scene Performance Expectations. This requirement served as the catalyst to develop response time standards for NWFD. CFAI defines response time differently than NFPA. CFAI defines response time as “calculated from the time point at which the alarm is reported (notification) to the time points when units arrive at the emergency event (on scene)” (CFAI, 2006, p. 70). CFAI’s travel time is defined as when an apparatus leaves a fixed facility and ends with the on-scene time. This is equivalent to NFPA’s definition of response time.

As part of the risk assessment process of developing a Standards of Response Coverage, NWFD defined two demand zones, Demand Zone A which represents the more developed, populated area of the District, and Demand Zone B that represents the more rural, less populated area of the District. Approximately 90 percent of the call volume occurs in Demand Zone A, approximately 10 percent occurs in Demand Zone B. As a result of the development of these demand zones, two different response time standards were adopted. These standards are represented in Table 1 below:

Table 1

NWFD response time standards

Resource	Response Time Standard Demand Zone A	Response Time Standard Demand Zone B
First due company	7 min. 30 seconds	10 min. 30 seconds
Initial Full Alarm	12 min. 0 seconds	15 minutes 0 seconds

The response time standards are based on an 80 percent fractile. These times are based on the CFAI's definition of response time that includes call processing, turn out time, and travel time. These standards were based on a review of response time data for the period of 2003-2005, as well as the anticipated effect on an additional rescue company placed in service in mid 2005 and the relocation of a station at approximately the same time period. Due to the District's relatively new experience at measuring response times and the uncertainty of how much effect the new rescue company and station relocation would have on response times, a fractile of 80 percent instead of 90 percent was chosen.

Since the response time standard was written in order to meet CFAI requirements, the determination of an equivalent NFPA response time (travel time by CFAI definition) requires some dissection of the CFAI response time standard. The call processing time and turn-out time need to be subtracted from the total response time. This appears on the surface to be a relatively easy task, until examined in more detail. NWFD has chosen to have several turn-out time standards, depending on whether it is a day or night call, and if it is a fire or EMS call. The different turn-out time standards are designed to account for whether crews need to don turn-outs for fire calls and account for additional time at night when crews may be asleep. As a result of these turn-out time classifications, turn-out time standards can vary from a low of one minute for EMS daytime calls) to a maximum of two minutes for nighttime fire calls. The call processing standard is much less complicated, using a standard of 1 minute 80percent of the time. It should be noted that the City of Tucson dispatches for NWFD, and the call processing time standard is for all practical purposes beyond the control of NWFD. Given this information and subtracting the call processing and turn out times, a NFPA 1710 response time standard range of four minutes, 30 seconds to five minutes 30 seconds is reached. This is obviously problematic in trying to compare “apples to apples” between CFAI response times and NFPA response times. To further complicate the comparison, NWFD uses an overall fractile percentage measurement tool of 80percent versus 90 percent as listed in NFPA 1910. In order to gain a more definitive look at NFPA response times (measured as travel time at NWFD), historical travel times need to be analyzed, which is addressed in the Results section of this ARP.

In 2001 NFPA adopted a standard as for the delivery of fire and EMS services to the public by career fire departments, NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations. “It sets minimum standards considered necessary for the provisions of public fire protection by career fire departments” (NFPA, 2004, p.1710-12). Among the minimum standards contained within NFPA 1710 is a provision for response times. Response times covered in the standard include:

- Four minutes or less for the arrival of the first arriving engine company at a fire suppression incident and/or eight minutes or less for the deployment of a full first alarm assignment at a fire suppression incident.
- Four minutes or less for the arrival of a unit with first responder or higher level capability.
- Eight minutes or less for the arrival an advanced life support unit.
- A performance objective of not less than 90 percent for the achievement of the time objectives.

The Northwest Fire District typically reviews and attempts to adopt applicable NFPA standards. Concerning the NFPA 1910 standard, NWFD fire chief Jeff Piechura stated that NWFD uses this standard as a planning tool will strive to meet the criteria listed in NFPA 1710 (personal interview, November 27, 2007).

A related document was also adopted in 2001 designed for rural, volunteer organizations. NFPA 1920, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments also includes provisions for response times.

NFPA 1720 Table 4.3.2 outlines various response times tied to demand zones, including urban, suburban, rural and remote. A more detailed discussion of this standard and its potential relationship to response times in NWFD is found in the Literature Review section of this ARP.

With the premise that response times are directly related to the outcome of the emergencies that the fire service responds to, this applied research project relates to all five of the USFA Operational Objectives:

1. Reduce the loss of life from fire in the age group 14 years old and below.
2. Reduce the loss of life from fire in the age group 65 years old and above.
3. Reduce the loss of life from fire of firefighters.
4. To promote within communities a comprehensive, multi-hazard risk reduction plan led by the fire service organization.
5. To respond appropriately in a timely manner to emerging issues.

The subject matter of this research relates to the following Executive Leadership skill/action areas, (1) ability to communicate, (2) ability to perform analysis and exercise judgment, and (3) relates to environment factors covered in the class such as organizational culture.

Literature Review

In 2001, NFPA 1710 - Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, was officially adopted by NFPA as a standard.

According to the standard, it centers on defining levels of service, deployment capabilities, and staffing levels for career departments. Work on the next edition of this

standard began almost immediately after the adoption of the first edition. In August of 2004, the second edition of NFPA 1710 was officially issued. All references in this ARP unless otherwise noted refer to the 2004 edition of NFPA 1710.

NFPA 1710, Section 3.3.37 defines four distinct time elements as it relates to the total response time.

- Alarm Time – The point of receipt of the emergency alarm at the public safety answering point (PSAP) to the point where sufficient information is known to the dispatcher to deploy applicable units to the emergency.
- Dispatch time – The point of receipt of the emergency alarm at the PSAP to the point where sufficient information is known to the dispatcher and applicable units are notified of the emergency.
- Turnout Time – The time beginning when units acknowledge notification of the emergency to the beginning point of response time.
- Response Time – The travel time that begins when units are en route to the emergency incident and ends when units arrive at the scene.

Section 4.1.2.1 of NFPA 1710 (2004) states that a fire department shall establish response time standards for fire and EMS events. These standards include:

- The first arriving engine company shall arrive within four minutes (240 seconds) at a fire suppression event and/or the balance of a full alarm assignment at a fire suppression event shall arrive within eight minutes (480 seconds).
- At an EMS event the unit with first responder or higher level capability shall arrive within four minutes (240 seconds).

- At an EMS event an advanced life support unit shall arrive within eight minutes (480 seconds).

The performance objective for the response time standards is not less than 90 percent for the achievement of each of the response time objectives. The standard does not expand on the statistical significance of the 90 percent fractile, nor does it offer how that number was reached. NFPA 1710 (2004) Annex A states that while the four minute response time by the initial company may not always be met, the eight minute response time for the full alarm should always be met. NFPA 1710 defines a full alarm as that response that can provide sufficient personnel to affect eight different fireground objectives. These objectives include incident command (one individual), uninterrupted water supply (one individual), fire flow of 300 gpm from two handlines (four individuals), provision for support person for each attack line (two individuals), one victim search and rescue team (two individuals), one ventilation team (two individuals), if an aerial device is in use, a dedicated operator (one individual), and the establishment of an initial rapid intervention team (two individuals). At NWFD, these objective requirements are accomplished with an alarm of two engine companies, one ladder company, one rescue company and one battalion chief. The critical tasks as described in NFPA 1710 are for a response to a structure fire in a typical two story, single family occupancy without a basement and with no exposures (2004). This is a very common structure in NWFD, residential structure fires represent approximately 75 percent of all structure fires in the district.

Besides a reference to flashover in the annex, there was no discussion or validation for the four minute and eight minute response time standards found in the

standard. It is noteworthy that NFPA has a disclaimer prominently listed near the beginning of the 1710 standard:

While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in this codes and standards (2004).

In 2001, NFPA 1720 was issued. This standard is the equivalent of NFPA 1710, but is designed for application by rural, primarily volunteer departments. Like NFPA 1710, a revised edition of NPFA 1720 was approved in 2004. In Chapter 1, the purpose of the standard is stated (1.2).

The purpose of this standard is to specify the minimum criteria addressing the effectiveness and efficiency of the volunteer public fire suppression operations, emergency medical service, and special operations delivery in protecting the citizens of the jurisdiction.

NFPA 1720 chooses to categorize response times by demand zones. Table 2 on the following outlines the response time requirements as listed in NFPA 1720, Section 4.3.

Table 2

NFPA 1920 staffing/response time standards

Demand Zone	Demographics	Staffing /Response Time	Fractile Percentage
urban	> 1000 people per sq.mi.	15 personnel/9 minutes	90
suburban	500-1000 people/sq.mi.	10 personnel/10 minutes	90
rural	< 500 people/sq.mi.	6 personnel/14 minutes	90
remote	Travel dist. > 8 miles	4/no req. response time	90

Until 2006, the NFPA 1910 and 1920 standards were essentially the only documents published by a nationally recognized fire service organization that addressed response time standards or guidelines. With the publication of the 7th Edition of the CFAI's Fire & Emergency Service Self-Assessment Manual (2006), there is now a second set of response time standards/guidelines for the fire service to consider. CFAI lists these response times in terms of benchmarks and baselines, and states that actual baseline performance should fall within the ranges as listed in the 7th edition document. CFAI has developed these benchmarks and baselines based on total population and/or population density. These population/density classifications include:

- Metropolitan – incorporated or unincorporated area with a population of over 200,000 and/or a population density over 3,000 people per square mile.
- Urban – incorporated or unincorporated area with a population of over 30,000 and/or a population density over 2,000 people per square mile.
- Suburban – incorporated or unincorporated area with a population of 10,000 to 29,000 and/or a population density of 1,000 to 2,000 people per square mile.
- Rural - incorporated or unincorporated area with a population of less than 10,000 people, or a population density of less than 1,000 people per square mile.

Table 3 on the following page summarizes CFAI's benchmark and baseline response time standards, including travel times only.

Table 3

CFAI response time standards

Demand Zone	CFAI Travel Times	
	Benchmark First unit/full alarm (minutes)	Baseline First unit/full alarm (minutes)
Metro/Urban (same)	4/8	5 m. 20s./ 10 m. 40 s.
Suburban	5/10	6 m. 50 s./ 13 m.
Rural	10/14	13/18 m.20 s.

In 2006 the United States Fire Administration as part of its Topical Research Series released a report titled Structure Fire Response Times (2006). The report describes total response time being made up of eight components that include ignition, combustion, call processing/dispatch time, turn-out time, drive time, set-up time and combat. There is also discussion of “Vertical Response”, the time it takes a crew with equipment to access a fire at a high rise or structures with large setbacks from the curb. However, there is no discussion whether there was any consideration of this time when analyzing the data. The report defines response time as used in the report as from alarm time (when the call was received by the fire department) to arrival on scene of the first apparatus. The report readily admits that the definition is vague and subjective, and there may be variance in how the data was reported.

The data used by the USFA report was gathered from National Fire Incident Reporting System 5.0 data for 2001 and 2002. The data was queried in whole numbers, which means that times of 4.0 minutes and 4 minutes 59 seconds were included in the 4 minute category. The analysis of data showed that response times were 5 minutes or less 50 percent of the time and less than 8 minutes 75 percent of the time. At the 90 percent fractile level response times were 11 minutes or less. The best response times were seen for fires occurring between noon and 6 p.m. The report did not differentiate between volunteer and full time fire department response time data. Several caveats regarding response times were covered in the report, these included:

- Arrival times are subjective and vulnerable to a variety of measurement errors regarding to when companies report their on scene times.
- The differing manners in which response times are measured and calculated contribute to error when trying to compile data from many different entities.
- It is difficult at best to measure some of the components of response times.

It is interesting to note that no data was gathered to determine the response times of a full alarm nor was there any delineations made regarding the staffing of the first arriving apparatus. Conceivably there could be data used in the development of the report that included apparatus with a single person on board.

Two large, prominent fire service organizations support the NFPA 1710 standard. Both the International Association of Fire Chiefs (IAFC) and the International Association of Fire Fighters (IAFF) supported the standard during its development and continue to support it at the time of this research. At the onset of its initial approval by the NFPA, the IAFC was clear in its support of the document.

ICHIEFS supports NFPA 1710 as a benchmark for the fire and emergency services, to assist in improving our service to the citizens we each serve. Every profession requires standards to operate at a satisfactory level and to establish benchmarks for future progress. This industry is no different, NFPA 1710 can help fire departments work toward a common ground: shared measurements that can gauge performance measures and provide realistic data to help improve services (IAFC staff).

The IAFF reflects similar unconditional support for NFPA 1710. “The passage of NFPA 1710 Standard is one of the most important advancements in fire service and public safety” (2007, IAFF website). In fact, the IAFF has developed three lesson plans designed to educate firefighters and the public regarding NFPA 1710 (2007).

The adoption of NFPA 1710 was not without its critics. Many groups were in opposition to the adoption of the standard, including the National League of Cities, U.S. Conference of Mayors, the International City/County Management Association, and the National Volunteer Council (Fletcher 2001). The National League of Cities went as far as to issue a press release that the NFPA had not provided any empirical evidence that the standards will achieve either objective of reducing fire losses or improving the safety of fire personnel (Atkinson, 2002). The cost of meeting NFPA 1710 response times can be of concern to fire service managers. The cost of purchasing additional apparatus, new fire stations, and hiring more personnel may need to be factored in when attempting to meet response time standards (editor, Fire Economics, 2001).

Much of the concern over the adoption of NFPA 1710 centered around the potential legal liability of the standard if a community did not adopt NFPA 1710.

Rukavina (2001) acknowledges that a community is assuming some additional legal risk by not adopting NFPA 1710. Rukavina describes that a large part of a negligence lawsuit against a fire department will be defining what a reasonable fire department should have done. It is in this context that relevant national standards would be called into play, including if applicable to the lawsuit, NFPA 1710. If the fire department's own standard was significantly different, or had no standard it could be argued the national standard be entered as evidence to be used by a jury as a benchmark to help it render a decision.

In the past, a doctrine of sovereign immunity has existed in a strong presence at the state level. However the trend is on the increase has been for states to consent to negligence actions (Schneid, 1996). Schneid states that fire departments have in the past relied heavily on the doctrine of sovereign immunity to avoid lawsuits based on negligence. As the application of this immunity clause continues to decrease, fire service organizations will be more vulnerable to negligence lawsuits.

According to NWFD's attorney, Thomas Benavidez, (personal interview, December 6, 2007) the liability NWFD assumes by not adopting NFPA 1710 is minimal. Benavidez stated that there is actually more liability in adopting NFPA 1710 and not meeting a particular measuring point of the standard, such as the response time. A hypothetical lawsuit example was brought up in an attempt to better understand the District's potential liability. The hypothetical lawsuit involves an individual suing the Fire District, stating that a response time that exceeded the NFPA 1710 standard contributed to the death of a family member. Given that the District's own response time standard for the response area that the call occurred in was six minutes, what would the District's potential liability be? Benavidez replied that the government entities such as

NWFD have minimal exposure in such cases as the elected officials have the freedom to allocate funding resources as they see fit, and are under no obligation to adopt national standards that are not mandated by law. In addition, the District has established its own performance measurement standards and was regularly measuring them to ensure the standards are being met. Given these two factors, Benavidez predicted that NWFD would prevail favorably in this scenario.

Donna Aversa, an attorney that represents a number of fire districts in central and southern Arizona, had a slightly differing opinion regarding if a fire district did not adopt NFPA 1710 (personal interview, December 9, 2007). Aversa felt that a fire district (assuming it is a paid professional department that meets the criteria of NFPA 1710) does have some potential liability if it does not adopt it. She felt that there could be the likelihood of damages awarded if it could be shown that the fire district could have met NFPA 1710 response times but chose not to. Aversa said it would be very dependent on the establishment of a “sympathetic jury” and how they viewed the local and state laws that governed the fire district. She agreed with Benavidez that there was a strong likelihood of liability for a fire district that chooses to adopt NFPA 1710 but does not meet the performance measurement objectives. If a fire district chooses not to adopt NFPA 1710, Aversa stated that a good risk management program should include steps that a fire district is taking to meet those standards.

The accuracy of reported response times becomes critical when organizations are attempting to meet performance measurements such as those listed in NFPA 1710. Coleman and Granito (1988) emphasize that the accuracy of the data is one of the first considerations when analyzing data. Cone and Davidson (1998) points out one

significant source of error in response times, that of when a unit reports on scene. In their study they found that 43percent of arrival times were reported early.

In recent years the Department of Homeland Security has sponsored the Staffing for Adequate Fire and Emergency Response Grant Program. According to the SAFER website, SAFER uses NFPA 1710 and 1720 when evaluating grant applications. Specifically SAFER considers section 5.2.4.2, Initial Full Alarm Assignment Capability and makes direct referral to the eight minute response time standard for the full alarm assignment. SAFER also directly refers to section 4.3 of NFPA 1710 (2004).

Automatic aid has been identified as a method to reduce response times. Chubb (2005) is direct about the advantages of automatic aid and the issue of why it isn't employed in more regional areas. "Too many fire departments still operate as fiefdoms rather than cooperating actively with their neighbors and seeking ways to improve their capabilities jointly" (p.136). Hoback (2001) in his research found that automatic would substantially reduce response times. The Phoenix Arizona valley has a large system of automatic aid that includes eighteen departments and districts (Phoenix Fire Department, 2007). NWFD observation at various fire and EMS related courses and conferences in the Phoenix valley over the years confirms that this automatic aid system works well to reduce response times. Nicholson (2000) states that agencies should be proactive in seeking automatic aid agreements to reduce response times and describes automatic aid as a reasonable step for public protection.

The International City/County Management Association (ICMA) found a direct correlation between response times and the spread of fire beyond the room of origin as well as the structure of origin (2007). The study also showed a relationship between

higher Public Protection Class ratings (as provided by the Insurance Services Office, Inc) and lower instances of fire spreading beyond the room of origin. Public Protection Class ratings, as derived from the Fire Suppression Rating Schedule, do not directly take into account response times in the rating calculation. However, the rating calculation uses a benchmark of a maximum of 1.5 miles travel for an engine company and 2.5 miles for a ladder company from their respective stations (2006). In a validation study of these travel distances, the RAND Corporation found that response times of 3.2 minutes for an engine company and 4.9 minutes are optimum. These times roughly correlate with the distance traveled as used by the PPC criteria; RAND established 35 mph as the average speed for fire apparatus responding in an emergency response mode.

A check of many fire department websites will find that they typically report their response times regardless of the definition of the term, in terms of an “average.” When response times are calculated in this manner essentially showing what a department is doing half of the time. Bailey and Sweeney describe this measurement as “inherently flawed because roughly 50 percent of the time response interval exceeds the preset standard” (2003, p.398). The Commission on Fire Accreditation International (2006) also caution against using an average for the calculation of response times. In the CFAI Self Assessment Manual, it alludes to the uncertainty of just what an average time reflects. In essence, an average time infers that 50 percent of the response times are longer than the average figure, a fact lost on most readers of an average response time statistic.

Coleman and Granito state that fire department officials need to establish a maximum response time. While they discuss some broad parameters for response times,

they stop short of defining specific recommendations for them (1988). They do however, discuss that flashover typically occurs in about seven minutes, and that permanent brain damage can occur after four minutes without oxygen. Coleman and Granito indicate these factors need to be considered when designing for defined response times.

In 1993 the Phoenix Fire Department prepared a report titled “A 3 Minute Response Time Goal, the Impact of Response Time on Fire Conditions and Victim Survival Profiles” (1993). In this report, PFD uses the following model for their basis of three minute response times:

- Fire detected and alarm activated – one minute
- Dispatch center call processing time – one minute
- Target travel time – three minutes
- On site actions before water is applied to the fire and rescue is initiated – two minutes.

In this model the total time elapsed is seven minutes. Conspicuously missing from this cascade of events model is turnout time. If the NFPA 1910 turn-out time standard of one minute is added, then the total time elapsed expands to eight minutes. If the turn-out time is intended to be included in the target travel time, then the true travel time interval shrinks to two minutes, which seems unrealistic, even in a well gridded street system such as Phoenix.

NFPA 1710 (2004) Annex A.5.2.2.2.1 discusses the importance of an early aggressive interior attack to reduce the loss of lives and property. The annex points toward the importance of the fire department intervening prior to the point of flashover. This section of the annex also includes a fire propagation curve that illustrates the point

of flashover generally occurs less than ten minutes from time of ignition, and shows a significant increase in frequency at about the seven minute mark.

The National Institute of Standards and Technology (NIST) (2001) has identified flashover as occurring in three specific circumstances in time periods much quicker than the seven to ten minutes that is typically found in various sources of literature. NIST describes flashover as occurring in 45 seconds in a typical sized living room with a dry Christmas tree. In a second simulation, NIST found that flashover occurred in approximately four minutes where the source of ignition occurred in a upholstered sofa. In the third simulation flashover occurred in about five minutes when the source of ignition occurred in a wastepaper basket which then spread to a office workstation module.

Several other resources indicate variances in the flashover time element. Waters (1999) refers to several studies that showed flashover occurring in as little as three to four minutes. Phoenix Fire Department (1993) found that in the dry desert climate of Arizona flashover can occur in approximately five to seven minutes after open flame occurs. The Commission on Fire Accreditation International (2006) describes flashover as typically occurring in three to eight minutes in modern residential structures. CFAI attributes quicker flashover times than in previous decades to increased fire loading, primarily due to the high content of hydrocarbons in household items/furnishings and increased insulation that has the effect of holding more heat in a structure. Zikmond (2001) states that most flashovers occur in the five to eight minute range.

The NFPA 1710 response time EMS standards can be traced to standards adopted by the American Ambulance Association and the Commission on the Accreditation of

Ambulance Services (International Association of Fire Chiefs, 2001). Pons and Markovchick (2002) researched the presumption that patient care and outcome will be better if ambulance response times are shorter. The study states that up to the time of the study, there had been no studies that were focused on the effect of ambulance response times on patient outcome other than cardiac arrest. “It is concerning that a response time standard for all ambulance responses was developed based upon the delivery of one particular intervention” (p. 47). Another study supports this concern, stating that except for cardiac arrest there is little or no research that suggests a relationship between response times and improved patient outcomes (Bailey and Sweeney, 2003). Pons and Markovchick’s study showed that ambulance response times did not have any effect on the survival rate for patients that received significant trauma that required admission to a trauma center.

In a study that tested the effect on the rate of survival for out of the hospital cardiac arrests, the of adding a program of advanced life support versus a program of rapid defibrillation, there was no improvement in the rate of survival with an ALS pre-hospital system (Stiell, Wells, et.al. 2004). The study concludes that EMS planners should place a heavier emphasis on the proactive side of service delivery, making a priority for citizen CPR instruction and rapid defibrillation (AED) responses.

Fitch (2005) describes five fundamental strategies for improving response times. His first strategy is match supply and demand. He suggests that through historical call analysis, deploying resources that match demand rather than in full 24 hour shifts is a better use of resources. An emphasis on resource deployment and planning necessary functions such as support and training services outside of peak demand periods is a more

effective use of resources. Fitch's second strategy is to manage component times and lost unit hours. The primary mechanism described for this strategy is to have measurement components in place to response times and in turn help provide direction for the system. Fitch emphasizes tracking exceptions to response time standards and taking corrective action when possible to reduce exceptions.

Running without lights and siren when it is not necessary is the theme of Fitch's third strategy. Having a tiered level of responses optimizes outcomes and helps minimize vehicle accidents. Clawson (2002) backs up this strategy, stating that running with lights and siren does not save significant time and contributes to vehicle accidents. Harnessing technology and innovations wisely makes up Fitch's fourth strategy. Geographic information systems and automatic vehicle locators are mentioned as two examples of proven technology that can enhance response times. Fitch's last strategy for improving response times includes being accountable and transparent. He emphasizes that an organization needs to be held accountable for performance and have open access to information regarding response times. Fitch asserts that the benefit of this accountability and transparency style of management is a higher level of trust created among stakeholders.

Procedures

Descriptive research methods were used to collect information about NFPA 1710, NWFD performance as it relates to the NFPA 1710 response time standards, how other departments and districts are dealing with the standards, and to help determine the significant factors that affect response times negatively. The descriptive research methods primarily consisted of four methods including research conducted at the

National Fire Academy's Learning Resource Center (LRC) in April and November of 2007, internet searches of various websites, personal interviews, a survey tool and in-house assistance by IT personnel to accumulate and report response times as well as to develop predictive outcomes of possible automatic aid solutions to response time issues.

Utilizing the LRC consisted of requesting a literature search from LRC staff using the key words "response times" and "NFPA 1710". LRC staff were able to produce an abundance of related references. In addition a three day research trip to the LRC was made in November 2007 to augment the research completed by the LRC staff. A variety of materials were reviewed that consisted of a selected textbooks, periodicals, journal articles, news sources, internet sites, and databases.

Early in the research an interview was conducted with the NWFD fire chief to determine what was NWFD's existing position regarding NFPA 1710. Additional personal interviews were conducted during the research period. These interviews consisted of interviewing two attorneys regarding the legal implications of NFPA 1710 and interviews of other regional fire department and district staff to determine their position regarding NFPA 1710 response times. Several interviews were also conducted with other NWFD staff members.

To measure how operations officers viewed potential factors that negatively affected their response times, a web-link survey tool was utilized. The survey was sent to all company officers and shift battalion chiefs. The survey was voluntary and anonymous. The survey is listed in Appendix A. A second survey using the same web survey tool was used to help measure the affect of companies from three stations that

have to access an adjacent major arterial roadway in order to initiate a response. This survey is found in Appendix B.

NWFD response time data was compiled from November 2006 to November 2007. This data was accessed using the district's FireHouse software and by querying the City of Tucson's dispatch data for NWFD. Additional response time data for the years 2003-2005 was accessed from NWFD's Standard of Response Coverage document. The data collected was limited to reported emergency runs, those with lights and siren. Both the existing and projected mileage polygons from various station locations were constructed using GIS ArcView software by NWFD staff. Mileage polygons were utilized as opposed to minute response parameters due to a lack of travel time database for stations and areas outside NWFD boundaries. Following an analysis of response times versus mileage for data available within NWFD boundaries, a relationship was developed between the two tools and GIS maps created. The relationship developed roughly correlated with the RAND Corp data referenced in the Literature Search section.

Using ArcView software, two response coverage area maps were produced. Appendix C is a map that outlines the 2.0 mile response polygons for existing NWFD stations. Appendix D is a map that outlines the 2.0 mile response polygons that include NWFD stations as well as adjacent Tucson Fire Department stations (3) and one Rural/Metro Corporation station. These maps were produced to illustrate the extended coverage that an automatic aid agreement with these two entities would produce.

Several limitations exist regarding the response time data gathered for NWFD. Current CAD configurations at the City of Tucson Dispatch does not readily allow for determining the collective arrival times of a full alarm. This must be done manually and

has been done for only certain periods of time the past few years, mostly compiled for grant writing purposes. As a result, there cannot be any conclusive statement about the compliance to the NFPA 1710 eight minute full alarm standard.

It is worthwhile to reiterate that this research was limited to the NFPA definition of response time, which is better known to most fire service management as travel time. It is recognized that there are a number of factors that fill out the cascade of events that contribute to a positive intervention of a particular emergency. These other factors include discovery of the emergency, notification to a dispatch center, transfer to an appropriate response agency, the dispatch of the call, turnout time, and intervention time.

Extensive examination of response times such as that found in the ICMA Comparative Performance Measurement: FY 2006 Data Report was not completed. Examination of this data was not completed primarily because of the varying degrees of definition of response times and the inability to use the data with any degree of confidence to compare “apples to apples”.

Definition of Terms

Automatic Aid: A plan developed between two or more fire departments for immediate joint response on first alarms.

Dispatch Time: The point of receipt of the emergency alarm at the public safety answering point to the point where sufficient information is known to the dispatcher and applicable units are notified of the emergency (NFPA, 2004).

Flashover: A transitional phase in the development of a compartment fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly throughout the space resulting in full room

involvement or total involvement of the compartment or enclosed area (NFPA 921, 2004)(b).

Response Time: The travel time that begins when units are en route to the emergency incident and ends when units arrive at the scene (NFPA, 2004).

Turnout Time: The time beginning when units acknowledge notification of the emergency to the beginning point of response time (NFPA, 2004).

Results

Research Question #1 - What is the present response time performance for NWFD?

For the period of December 1, 2006 through November 30, 2007 NWFD met the NFPA 1710 response time standard of four minutes 57 percent of the time. This included all emergency runs by rescue, engine and ladder companies. The CAD software utilized by the City of Tucson Dispatch Center (NWFD's contract dispatching agency) does not readily lend itself to accessing the response time performance of a full alarm, which at NWFD consists of two four-person engine companies, a four person ladder company, a two person rescue company, and a battalion chief. However, manually produced data that was gathered for grant writing purposes in a six month period in 2006 showed that NWFD met the NFPA 1710 response time standard of eight minutes 0percent of the time.

Research Question #2 - What are the NFPA response time standards based on?

Revisiting the NFPA 1710 response time standards for fires, they are four minutes or less for the first due engine company and eight minutes or less for the full alarm.

NFPA 1710 Annex A.5.2.2.2.1 (2004) states that a room typically flashes over at approximately 10 minutes. As a result, this annex goes on to emphasize that two of the most important factors in limiting fire spread and damage is (1) the quick arrival of

resources that include sufficient personnel and equipment to accomplish fire control, and (2) the extinguishment of the fire as close to the area of origin as possible. Presumably, the eight minute response time standard is established so that an initial attack line is on the fire in six to seven minutes and other critical tasks such as ventilation are underway at the near the eight minute mark.

NFPA 1710 (2004) response time standards for EMS calls are four minutes or less for a first responder unit, and eight minutes or less for the arrival of an advanced life support unit. Unlike the fire response time, Annex A does not offer any evidence for the establishment of the EMS response time standards. However, there is ample research published that shows brain death begins four to six minutes after a victim experiences cardiac arrest. The American Heart Association (2007) is probably best known for the publicity surrounding this statistic. An assumption can be drawn from this statistic that the NFPA 1710 EMS response times are primarily based on this, especially since the literature search for this ARP uncovered little other research regarding time versus outcome for other medical conditions.

Research question #3- Are there other professional fire/EMS organizations that are meeting NFPA 1710 response time standards and if so, how are they accomplishing them?

The city of Austin Texas currently meets NFPA 1710 response time standards. Kinsey (2002) describes several factors that led to this performance and challenges encountered along the way. In 2000, Austin Fire Department (AFD) began issuing performance reports regarding response times. These reports were distributed to all stations and were categorized by station as well as shift. An improvement in response

times was noted the next month. AFD attributes the improvement to the fact that a competitive drive was sparked among the stations and shifts. Another explanation may be attributed to the Hawthorne effect, the phenomenon in which subjects in behavioral studies change their performance in response to being observed. AFD also developed a performance standard for officers that focused on consistency, rather than speed of response. For example, their response time standard for battalion chiefs is within eight percent of the station average for 75 percent of stations within the battalion.

AFD encourages a problem solving approach to response times outside of the standard. This encourages solutions from the field and ultimately results in better response times. AFD also experienced an improvement in response times following the installation of mobile data terminals that allowed for the input and instant recording of en route and arrival times without the use of microphones and human input at the dispatch center. While this resulted in an improvement in response times, AFD found that they needed to create a standard for officers to be sure they inputted their en route and on scenes times. This standard was put into place as officers were forgetting to “hit the button” on the mobile data terminals.

Minneapolis Fire Department (MFD) is close to meeting NFPA 1710 response times, citing 85 percent compliance (Craigle, 2002). MFD lists two primary reasons that their response times are nearly within NFPA 1710 standards, the use of Opticom traffic light management system and good street planning which in turn allows for relatively unobstructed travel routes with few dead-ends. The City of Coppell TX meets NFPA 1710 response times and also gives credit to an Opticom traffic pre-emption system (Krus, 2002). Coppell also cites strategic planning of station placement as a significant

factor in meeting their response time goals. Bryan Texas Fire Department meets NFPA 1710 response times and also credits the appropriate placement of stations as a contributing factor (Sivils, 2002). In addition, Coppell gives credit to their automatic aid agreement with the adjoining city of College Station.

Other fire departments/districts similar in organization structure and/or size to NWFD were contacted directly to determine their position with NFPA 1710 response times and if they were meeting those associated standards. Golder Ranch Fire District, a neighboring progressive fire district about half the size of NWFD, was contacted. They report that they generally have a four minute NFPA defined response time 65 to 80 percent of the time (A. Smith, personal communication, December 15, 2007). They view the NFPA response time standard as a goal, and recognize they cannot meet it with current resources. Santa Fe NM Fire Department has a response time goal of six to seven minutes that includes turn out time, and is reported as an average (T. Selleter, personal communication, December 20, 2007). Their current performance is an average response time is six minutes 38 seconds. Santa Fe FD has six stations, serves 41 square miles and the department has no plans to adopt NFPA 1710 standards.

Redmond WA Fire Department reported that they currently report average response times and do not have a response time standard or goal, but that it is being looked at to adopt a standard (D. DeLuche, personal communication, December 20, 2007). Redmond serves 45 square miles with six stations and approximately 140 personnel. Sun City AZ Fire District has a goal of responding in four minutes that includes turn out and travel time (R. Gilbert, personnel communication, December 21, 2007). Gilbert was uncertain if the fire district will adopt the NFPA response times as a

standard. Sun City FD has approximately 60 personnel and serves 71,000 people. Mesa AZ Fire Department has a four minute response time 75 percent of the time (2005), their goal is to meet the NFPA 1710 response time (90 percent). Mesa has 17 stations with approximately 450 members.

Research Question #4 - What are the major tangible factors at NWFD that are contributing to not meeting NFPA 1710 response times?

In order to help identify factors that are contributing to NWFD not meeting NFPA 1710 response times a survey was sent to all shift captains and battalion chiefs. The survey was voluntary and is included in Appendix A. A total of 23 responses out of 33 surveys sent were received for a response percentage rate of 70 percent. The survey listed seven response time factors for the respondent to rate as low, moderate or high impact on response times. The factors listed on the survey included:

- Road conditions (rough road, narrow winding roads, etc, not including weather conditions).
- Lack of a regular road grid system, such as that found in mid-town Tucson.
- Traffic congestion
- Drivers not yielding the right of way
- RR crossings
- Area familiarity (experience with first-due area).
- Other (please specify)

The response time factor that had the greatest number of “high impact” responses was traffic congestion. This was the number rated factor by over 13 percentage points, a significant difference. The second highest number of responses in the “high impact

category was drivers not yielding the right of way. The category by far producing the highest number responses for “low impact” was area familiarity. A category not listed in the survey but listed in the “other” section of the survey by two respondents was that of gated communities. This additional category was listed as a “high impact” by both respondents.

An additional survey was developed for captains assigned to NWFD stations adjacent to major arterial streets. The survey was sent via email to nine captains at the three affected stations. A total of seven surveys were completed for a completion percentage of 78 percent. Companies assigned to these stations presumably encounter delays in response times due to accessing these arterial streets. The respondents were asked to consider responses during the hours of 0700 and 1900 hours, the hours of peak traffic. None of the ingress paths to these streets have traffic control devices for companies to activate. This survey can be found in Appendix B. The majority of respondents were split evenly regarding the percentage of time that companies were delayed as a result of waiting for traffic to clear on the adjacent arterial street.

Approximately 29 percent stated that they were delayed 25-50 percent of the time, an additional 29 percent stated that they were delayed 51-75 percent of the time. 14 percent stated they were delayed 76-100 percent of the time, and an additional 14 percent stated that they experienced no delay in accessing the adjacent arterial street near their station. The majority of respondents (42 percent) reported that they typically experienced a delay of 10-15 seconds, an additional 29 percent reported a delay of 16-20 percent. An equal percentage of remaining respondents reported a delay of less than ten seconds or greater than 20 seconds.

The final question of this second survey asked these captains if the addition of a traffic control device at the point of ingress of the responding fire companies would substantially reduce or eliminate delays accessing the major arterial roadway. A total of 86 percent either agreed or strongly agreed with the statement. One respondent disagreed with the statement.

Not included in the surveys but a topic of conversation within NWFD over the effect they have on response times is that of speed humps/bumps. Sometimes known as traffic control devices, a single field test several years ago at NWFD showed that a delay of approximately 10 seconds per speed bump was observed, when compared to traveling at 25 mph on a roadway without the speed bump.

The current method NWFD uses to communicate “en route” and “on scene” is done via the vehicle’s two-way radio. This introduces the possibility of a significant time interval in the form of its own “cascade of events”, adding time to the turn out and travel time intervals. This unique set of cascade of events includes the act of picking up the microphone to talk, communicating to Dispatch that company is en route, the acknowledgement by the dispatcher, and the physical act of the dispatcher to key stroke the appropriate action into the keyboard. In an informal study performed in 2005, response time logs kept by captains compared to times recorded by City Dispatch showed the length of time delay in recording the en route and on scene times typically resulted in extending both the turn out and travel times by a range of ten to 45 seconds, sometimes longer.

The extended delays, 30-45 seconds and more in some cases, as explained by supervisory personnel at Dispatch are most likely due to dispatchers dealing with more

than one unit at that particular time, and were not able to immediately input the communication at the time it was made over the air. Further contributing to this introduced artificial time delay is when there is a multiple company response. Often companies must “wait their turn” to communicate their en route time and arrival times with City Dispatch. NWFD is currently in the process of installing mobile data computers in all units, this is further addressed in the Discussion section.

During the creation of the Standard of Response Coverage document in 2006, it was recognized that there mitigating circumstances that sometimes contribute to longer response times. It is desirable to isolate these responses and address them separately from the fractile statistics that are generated for response times. To address this situation, a new field was generated in the FireHouse reporting system that the District uses. This exception reporting system included such categories as storm conditions, delayed by train, road closures, down grading to a non-emergency response en route based on additional information. The fire officer could choose from to identify factors that delayed their response. While this system was implemented, a review of this system as part of the research for this paper revealed the system is not being used by the officers. An informal survey of several officers indicated that some new officers did not know the system existed and other more senior officers were not certain how they should use it so they had chosen not to use it at all.

Discussion

It became readily apparent during the literature review that there is no single standard for the definition of response time. The United States Fire Administration defines response time as when the alarm time is received by the fire department to arrival

time on scene. The Commission on Fire Accreditation International defines response time as call processing time, turn-out time, and response time. NFPA 1710 defines response time as the time beginning when units acknowledge notification of the emergency to the beginning point of response time. The differing definitions among these leading organizations in the fire service make it difficult to accurately compare response times across the country. As a result, there is a lack of reliable information regarding the NFPA 1710 definition of response time. Also contributing to this issue is the apparent low numbers of fire departments that have adopted or at least measuring response times as defined in NFPA 1710.

There is substantial variation in the research concerning the time to flashover conditions. The annex of NFPA 1710 (2004) generally describes flashover as occurring in approximately 10 minutes. Other research (Phoenix FD, 1993, Zikmond, 2001) indicate that flashover can occur anywhere from three to eight minutes. This wide arrange is substantiated by research by Babrauskas, Peacock and Reneke (2003) whose research showed that flashover in a room with common fire loads can occur in a range of three to six minutes. Given the wide range of time that various research studies have indicated, using the assumption that most flashovers occur at roughly ten minutes to base the full alarm NFPA 1710 response time standard of eight minutes appears to be flawed. In addition, this time line is predicated on the assumption a fire is discovered in its earliest stage.

When looking at the NFPA 1710 annex material that states most flashovers occur at approximately the ten minute mark, the chances of successful intervention appear

marginal. A summation of time in a theoretical, arguably realistic cascade of events is summarized in Table 4.

Table 4

Theoretical cascade of events and associated times for structure fire

Time to discovery	1 minute
notification/transfer of call from PSAP	1 minute
Call processing	1 minute
Turn out time	1.5 minute
Travel time	3 minutes
Preparation for intervention (hose deployment, water supply etc.	1 minute
Total time elapsed to initial intervention	8.5 minutes

An estimated total time of eight and a half minutes in this scenario would place the first due engine company at or past most instances of flashover as researched in this project. According to NFPA 1710 response time standards, the remaining companies responding may or may not be on the scene with the initial company. Since most fire stations are single company stations, it is likely that the second company would be arriving closer to the eight minute mark and just beginning a firefighting tactic, such as ventilation, a key tactic in preventing flashover. While there is no question that the sooner suppression and rescue efforts can begin at a fire the less loss of life and property will occur, the eight minute response time standard cannot be validated solely on the premise of the prevention of flashover.

The NFPA 1710 (2004) response time standard of four minutes (BLS) and eight minutes (ALS) appears to rest only on the research of brain death occurring four to six minutes after cardiac arrest. Additional research (Bailey and Sweeney, 2003, Pons and Markovchick, (2002) has not shown a clear relationship between response times and patient outcomes. As a result, the NFPA 1710 standard is using a single patient condition, cardiac arrest, to base its entire EMS response matrix on. A review of NWFD's EMS call types in 2005 (NWFD, 2006) shows that cardiac arrest calls represented one percent of the total EMS call volume. Based on the research uncovered for this project and the frequency of cardiac arrest calls, there appears room for adjustment of this response time based on the nature of the call.

Some research (Stiell, Wells, et. al. 2004) indicates that cardiac arrest intervention efforts may be better directed at other methods by besides the emphasis of rapid ALS response. This research along with other documentation that CPR and early defibrillation (Ludwig, (2004) is more effective for patient outcome than early arrival of ALS personnel, indicates that this potential paradigm shift is worthy of serious consideration.

While there is the preponderance of research completed for this project indicates that in its simplest terms, response times may not be as important as one would inherently assume, the fact remains that public expectations are that their fire department arrive quickly (University of Arizona, 2006, Brewster, 1996.), the general response time expectation appears to be about five minutes, close to the NFPA 1710 response time standard for a single company. NWFD will need to keep this reality in mind when reviewing and modifying response time standards.

The recent attention on tax reform (Arizona Federation of Taxpayers, 2007) clearly focuses on the importance of performance measurements for NWFD. Response times is one of the best know performance measurements to the public and no doubt will become more of an item of scrutiny in the near future. NWFD will need to regularly measure response times and strive to reach national response time standards such as those listed in NFPA 1710.

Response times for the period of December 2006 through November 2007 indicate that NWFD is falling well short of NFPA 1710 response times. Several improvements scheduled for the near future should have a positive impact on response times. These improvements include the construction of an additional station, the installation of mobile data computers, and the implementation of a two person BLS response company designed to relieve the some of the call load of ALS companies. NWFD currently utilizes one peak activity company, in service during peak hours of call demand, Monday through Friday. There is on-going research to determine the possible need of a second peak activity unit.

A cursory review of response times at NWFD indicates that the stations in the less developed areas have response times that significantly longer than stations in the higher density, more developed areas of NWFD. While this makes sense from an operational form a concentration and distribution of resources point of view, the reality is that there are a number of incidents that fall well outside NFPA 1710 response times, and in the foreseeable future the less developed areas of the District will continue to contribute to extended response times. NFPA 1920 (2004) while in title seemingly is designed for volunteer/combination departments and districts, appears to have application at NWFD.

Over 50percent of the area NWFD covers is low density, with a significant amount of the total District totally undeveloped. During the accreditation process this profile was recognized and two demand zones were created with corresponding differing response time standards. In essence the foundation is already created for applying the response time standards from both NFPA 1710 and 1720.

Review of surveys from other applied research projects and other sources as well as direct contacts made with other departments and districts indicate that there appears to be few districts and departments that are meeting NFPA 1710 response time standards. Of those that do, it appears the most common denominators are a high concentration and distribution of resources and a well designed street system. The common theme of the research completed in this area appears that districts and departments are at best looking at NPFA 1710 response times as guidelines.

The survey sent to all shift captains and battalion chiefs showed that traffic congestion had the greatest affect on response times, with drivers failing to yield the right of way second in the survey. There is little NWFD can do to alleviate the traffic congestion. The town of Marana and the northwest area of suburban Tucson that NWFD serves is a rapidly growing area, with adequate infrastructure such as an effective roadway system lacking. This problem will likely continue to get worse as growth continues. The flip side of the problem is growth will also contribute to additional tax revenue to apply to response time issues that can be addressed to some degree.

While drivers not yielding the right of way has long recognized as a problem, it was somewhat surprising to see it ranked as high as it was. There has been some effort by the District to educate the public of the importance of yielding the right of way, but

has mostly consisted of hit and miss media coverage. Montgomery County MD recognized a similar problem several years ago that was brought to the forefront as a result of one of their ambulances being involved in a serious collision (Montgomery County FD, 2005). One of the firefighter/medic involved in the collision began a program of driver awareness, titled "Hear Us, See Us, Clear for Us". The program is highly structured with many facets. The obvious benefit besides the desired outcome for reduced response times is an increased level of safety for responders. The latest data for 2007 firefighter deaths shows again a significant percentage (20.8 percent) attributed to vehicle collisions of various types (USFA, 2008).

Of the remaining factors identified in the shift captain and battalion chief survey the only factors that NWFD has the ability to influence are area familiarity, gated communities, and to a minor extent, traffic calming devices. The remaining factors such as road construction and RR crossings are generally beyond the control of NWFD to affect.

The results of the survey completed by captains at stations with ingress issues to adjacent major arterial roadways supported the installation of traffic control devices at the intersection of ingress by the fire units. A captain assigned to one of the stations included in this survey spoke of the many near misses he has witnessed due to traffic attempting to stop to allow ingress of a fire apparatus (W.Worden, personal communication, November 14, 2007). In the past there have been numerous attempts to work with both Pima County and the Town of Marana to install such devices, at the expense of NWFD. These attempts to date have not met with success (J.Kahle, personal communication, November 2, 2007).

Often during a research project, the research begins to build a pattern such that the initial intent of the research is somewhat overshadowed by research discovered that to some degree, steers one away from the original problem. Such is the case with the research with this project. Much of the literature research for flashover varied widely from the ten minutes discussed in the NFPA 1710 annex. Waters (1999) references flashover times of four to six minutes. Faced with data like this, Waters came to take a stand much different than that implied by NFPA 1710 annex A, “It would be in nearly impossible for the fire department to achieve a goal of applying an extinguishing agent on a fire before flashover (p.107)”. Coupled with research that shows that CPR and early defibrillation is more effective at influencing patient outcome than the arrival of ALS personnel, the importance of meeting the NFPA 1901 response time standards starts to fade and the often dim light shown on prevention activities begins to brighten exponentially.

The research clearly indicates that we need to focus more attention on preventing the emergency for the public, there does not need to be a exorbitant amount of time and money spent on a study to determine which choice the public would make – prevent an occurrence or have the event happen and have a big red fire engine there in less than four minutes. While there is a solid argument for moving current response times at NWFD closer to the NFPA 1710 standards, there appears to be a stronger argument for placing more emphasis on preventing the emergency. Ironically, preventing more emergencies will have a positive effect on response times by increasing the availability of companies to respond and in turn reducing response times. While the identification of factors that are contributing to extended response times was an important result of this paper as well

as the subsequent recommendations that follow, the identification of the apparent fact that efforts may be better directed to associated prevention efforts is the major finding of the research for this project.

Recommendations

1. Although efforts have been made in the past to install traffic control devices on major arterial streets adjacent to NWFD fire stations, further efforts are needed. The safety aspect is well documented and Tucson Fire (E. Nied, personal communication, December 4, 2007) reports that their traffic control devices save significant time and enhance safety for both the public and the fire department personnel.
2. Initial research as part of this report indicates that NWFD could benefit from automatic aid from three of Tucson fire station locations and one Rural/Metro fire station. Traditionally NWFD has not pursued automatic aid with Rural Metro due to state statutes prohibiting government entities from potentially subsidizing a private company. Training and staffing issues have also been a concern in the past. The development of a contract with Rural Metro would be a legal method of entering into an automatic aid agreement. The training and staffing issues would of course need to be determined prior to entering into any type of agreement with this entity. Tucson Fire Department (TFD) has long resisted automatic aid with NWFD for a number of reasons. However, there has been a change in management philosophy the past few years at TFD and it may be time to approach them again regarding this subject.

3. A formal, well structured public educational program regarding yielding to emergency vehicles such as that established in Montgomery County MD (2005) should be established. There would appear to be ample partnering opportunities with a program of this type.
4. Work should continue on other service delivery methods for non-emergency services such snake removals, BLS calls, and smoke detector battery changes,
5. Response time standards that were established as part of the Standards of Response Coverage document in 2006 should be re-visited and potentially re-defined. The CFAI (2006) response time standards that are population density based should be reviewed for application at NWFD.
6. Based on the Austin Fire Department research (Kinsey, 2002) response time reporting to all stations and shifts should be done as a matter of standard procedure. This was initially done at the onset of the accreditation process, but has lost momentum in recent months.
7. A much larger emphasis on preventing incidents should be considered. Prevention efforts should include the adoption of an aggressive residential sprinkler code, a more aggressive, comprehensive, multi faceted residential fire prevention program that includes several delivery systems and a performance measurement component. EMS prevention activities such as CPR and the active marketing of automatic defibrillation devices and the associated training should also receive more priority. These are all components that perhaps should be part of a new community risk reduction program, with a heavy emphasis on measurable outputs and outcomes.

8. The development of a Response Time Task Group should be considered. This group would not only consider response time as defined by NFPA 1710, but also other aspects of the customer interval that would include call processing and turn out times as well. This could be a “think-tank” group, as well as a mechanism for further research on response factors covered in this project as well as other factors identified by the group.

Future readers may want to perform additional research regarding the current NFPA 1710 response time standards and the premise on which they are based.

Additional research is also needed regarding a cost versus benefit analysis regarding an equivalent number of dollars spent in prevention efforts as compared to suppression – which is the fire service’s best “bang for the buck”.

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Appendix A

Factors that influence travel time – survey and results

Shift captains and battalion chiefs

1. My assigned station is:

station ____.

2. Please rate the following travel time factors regarding the impact they have on your code three travel times. Your ratings should be reflective of typical response conditions in your first due area. Travel time is defined as the time from when you are en route until the time you arrive on scene.

	Low Impact	Mod. Impact	High Impact
• Road conditions - rough road, narrow winding roads, etc.	43.5%	30.4%	30.4%
• Lack of a regular road grid system such as that found in mid-town Tucson.	26.1%	47.8%	26.1%
• Road construction	26.1%	43.5%	30.4%
• Traffic congestion	30.4%	17.4%	52.2%
• Drivers not yielding the right of way.	30.4%	30.4%	39.1%
• RR crossings	39.1%	47.8%	13.0%
• Area familiarity (experience with first-due area)	60.9%	30.4%	8.7%

Appendix B

Station 30, 33 and 38 egress traffic survey

1. My assigned station is _

Station 30 3

Station 33 3

Station 38 1

2. Between the hours of 0700 and 1900 hours I estimate that our code 3 response is delayed approximately ____% of the time due to waiting for traffic to yield in order to gain access to the major adjacent arterial street.

<25% 1 respondent

25-50% 2

51-75% 2

76-100% 1

No delay 0

3. When we are delayed gaining access to the adjacent major arterial street between the hours of 0700 and 1900, I estimate it typically delays our code 3 response by ____ seconds.

<10 seconds 1 respondent

10-15 seconds 3

16-20 seconds 2

> 25 seconds 1

Appendix B (con't)

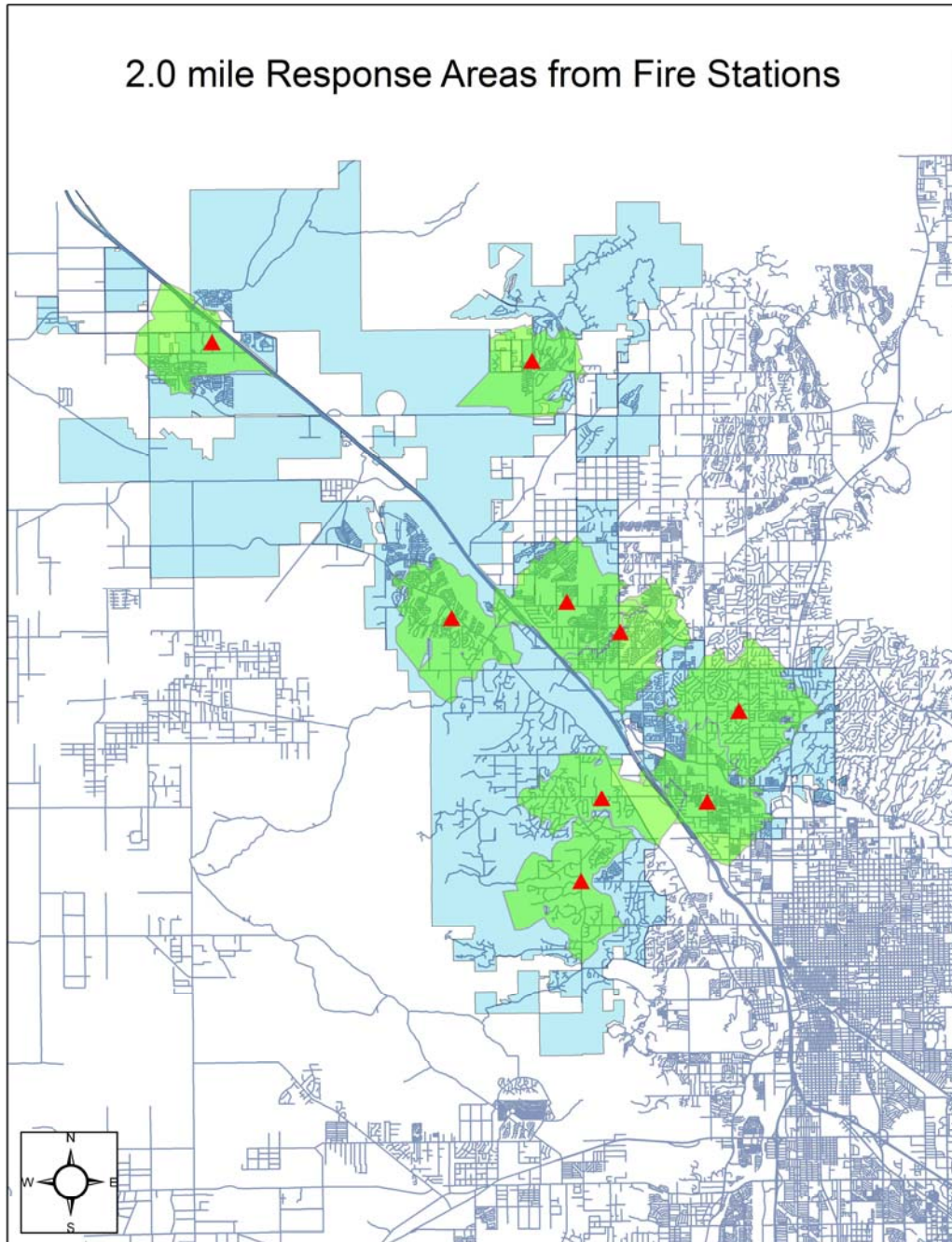
4. A traffic control device (signal) activated by the responding company would substantially reduce or eliminate delays accessing the major arterial street.

Strongly agree	3 respondents
Agree	3
Not sure	0

Appendix C

Northwest Fire/Rescue station locations

With 2 mile response area polygons, blue shaded area is NWFD



Appendix D

NWFD stations with TFD and RMFD stations

Automatic aid map, 2 mile polygon response area

